in a methanol-Na$_2$S solution. Both procedures yield transparent polymers with a light yellow to orange color. The yellow color, after photopolymerization of the binary mixtures with UV irradiation for two hours, indicates formation of CdS nanoparticles. The properties of the *in-situ* synthesized CdS nanoparticles were determined by UV-Vis and photoluminescence spectroscopy. Optical spectroscopy of the CdS-polymer composite shows a dramatic increase in the absorption at 450 nm. Moreover, this CdS impregnated polymer exhibits a fluorescence band located at 473 nm, whereas the control polymer showed no distinct bands. The polymerization described in this paper yields a material with improved mechanical properties, which can be both readily processed and applied in technologically relevant applications and environments.

Microbiologically Influenced Corrosion in Oil Pipelines: Causes and Effective Treatments. BRENDEN VAN SLYKE (*State University of New York at Stony Brook, Stony Brook, NY*); BRENDEN VAN SLYKE (*Brookhaven National Laboratory, Upton, NY*). Microbiologically Influenced Corrosion (MIC) is a serious problem in the oil industry. During oil extraction, especially secondary recovery, water may become mixed with the oil. This water can harbor microorganisms, that when not controlled can cause serious corrosion due to their metabolic processes. Two particularly damaging and widespread forms of bacteria involved in MIC are sulfate reducing bacteria (SRB) and acid producing bacteria (APB). The initial phase of this project was literature research into the causes and mechanisms for MIC. Then this information was applied to examining photographs and replicas of a pipeline suffering from possible MIC. Based on this examination, information on different treatment options were researched. The literature research aspects of the project were undertaken using electronic media such as the Internet and online journals, correspondence with industry officials and scientific researchers, and printed material. Literature research into the causes of MIC led to two distinct areas of interest. The first of these was the human factor, which dealt with poor maintenance and improper use of biocides allowing bacteria to proliferate in the system. On the bacteria side, the SRB and APB formed colonies with themselves and other non-corrosive bacteria. The bacteria can influence corrosion by the production of corrosive metabolites, hydrogen sulfide in the case of SRB and organic acids with APB present. SRB also can stimulate the development of iron sulfide deposits, which increase corrosion by enlarging the cathode. Furthermore, acids produced by APB can also complex with metal ions at the anode, removing them and accelerating the corrosion reaction. The replica casting were made from actual corroded oil pipe using Struers Repliset kits. These were then sputter coated using an Anatech Hummer VII to show more contrast. After examining the photographic evidence and replicas three types of corrosion were suspected. Two cases of MIC, one each by SRB and APB, were determined. One sample showed inorganic carbon dioxide corrosion and a fourth section exhibited an undetermined form of corrosion. The most important factor in limiting MIC is keeping oil pipelines clean and as water free as possible. Biocides containing glutaraldehyde as the active agent and quaternary ammonium compounds to break up biofilms are suggested. This project is part of a larger investigation into oil pipeline corrosion, which is ongoing.

Effect of Chemistry Variations on the Microstructure and Mechanical Properties of Creep Strength Enhanced Ferritic Steels. KEELY WILSON (*Michigan Technological University, Houghton, MI*); JOHN SHINGLEDECKER (*Oak Ridge National Laboratory, Oak Ridge, TN*). Grades 91, 92, and 122 steels (9–12% Chromium) are known as Creep Strength Enhanced Ferritic steels. These grades of steel are finding increased usage in the pressure retention components of advanced fossil energy systems (Ultrasupercritical Steam Boilers, Heat Recovery Steam Generators, etc.) because of their superior performance in high temperature, high stress environments. The chemical specifications for these grades are very broad, which may affect the mechanical properties and long-term performance of the alloy in service. Ideally in the normalized and tempered condition, Gr 91, 92, and 122, will have fully martensitic structures with no ferrite forming. In an earlier study, two compositions of each grade were produced by varying the amounts of austenite formers (C, Mn, Ni, N) and ferrite formers (Si, Cr, Mo, V, Nb) within the current specification range. These chemistry changes were guided by computational thermodynamics to alter the intercritical temperatures, the temperatures at which steel changes phase, and to cause the formation of ferrite under standard processing conditions. In this study, the mechanical properties of these samples were evaluated, and are compared to literature results for commercially produced material. High temperature (650°C) creep tests were run with loads ranging from 100 to 140 MPa for times exceeding

1,000 hours. Tensile tests were run at both high temperature (650°C) and room temperature (25°C). Digital Imaging software was used to analyze the steel microstructures to determine the amount of martensite and ferrite present in each alloy. It was found that both the tensile strength and the creep strength of the alloys decreased substantially with the presence of ferrite in the material. This critical finding clearly shows that the specification range for these alloys is too broad which may result in commercially produced materials with properties far from expectations. A limited evaluation of thermodynamic predictions and microstructural findings was also conducted. The data collected in this study, combined with data from other tests, such as long term creep tests, thermo-mechanical simulation, and thermodynamic modeling will later be used to create more specific standards for Gr 91, 92 and 122 alloys.

Synthesis of Calix[4]cyclohexanol to Serve as an Electron Trap. BENJAMIN ZALISKO (*Elmhurst College, Elmhurst, IL*); JOHN A. SCHLUETER (*Argonne National Laboratory, Argonne, IL*). Electrons are known to be trapped between positive charges of liquid water and alcohol molecules without being incorporated into the molecules' electron shells. Seeking to trap an electron within a single molecule, calix[2]cyclohexanol should be synthesized by hydrogenation of calix[4]arene at 200 psi and 90°C, resulting in calix[2]cyclohexanone. This should be followed by reduction with NaBH$_4$ to produce calix[2]cyclohexanol. Using an electron donor (Na metal or electrolysis), an electron should become trapped between the partially positive, tetrahedral hydrogen atoms of the internal hydroxyl groups of calix[2]cyclohexanol. This trapped electron's presence will be confirmed by its ability to retain magnetic spin with electron spin resonance spectroscopy. Acting as a capacitor, this electron trap will retain electron spin efficiently and could lead to further studies of conduction, electron spintronics, and even new media for micro processing.

Cadmium-doped SiO$_2$ Nanoparticle Label for the Electrochemical Immunodetection of Protein IgG. XIAOHAI ZHANG (*University of Washington, Seattle, WA*); JUN WANG (*Pacific Northwest National Laboratory, Richland, WA*). Semiconducting nanoparticles have garnered enormous attention in the field of biosensor development within the past decade. Due to recent advancements in the control of their growth size and shape, nanoparticles such as silica MCM-41, which have unique structural functionalities, are now an applicable material in creating novel methods of bio-detection. In this report, an amperometric biosensor using biochemically modified silica nanoparticles was developed for the detection of protein IgG via sandwich immunoassay. This novel electrochemical immunosensor is based on the encapsulation of Cadmium ions within mesoporous aluminosilicate nanoparticles (SiNPs) MCM-41. The synthesized silica NPs — antibody conjugates were then characterized with electrochemical detection as well as UV spectrum analysis. Preliminary tests have confirmed that Cadmium ions were immobilized inside the mesoporous shell of the silica NPs; they've also shown that the protein antibodies were successfully conjugated. In these experiments, the performance of the electrochemical immunosensor was evaluated via carbon Screen Printed Electrodes (SPE), and a detection sensitivity of 10 ppm was achieved. This report has shown that SiNPs has great potential for future research and development of electrochemical bio-sensors; however, optimizations in its synthesis method are still required to increase the detection limit. Cadmium labeled silica NPs offers a viable approach for the rapid, simple, and cost-effective analysis of biological samples.

Medical and Health Sciences

Determining the Optical Properties of Biological Tissue Samples Using an Integrating Sphere Method. MARCUS ALLEGOOD (*North Georgia College and State University, Dahlonega, GA*); JUSTIN S. BABA (*Oak Ridge National Laboratory, Oak Ridge, TN*). Wavelength dependent light interaction with biological tissue can be described using three parameters: the scattering and absorption coefficients and the cosine of the average scattering angle (g). To accurately determine these optical properties for different types of tissue at specific wavelengths would be beneficial for a variety of different biomedical applications. The goal of this project was to take a user defined g-value and determine the remaining two parameters for a specified range of wavelengths. In order to collect the needed data for all the wavelengths in a timely and accurate manner, a fully automated computer program and process was developed. Using a single integrating sphere method, scattered light intensity inside the sphere was recorded via a spectrometer as either transmitted or reflected light from the tissue sample. LabVIEW was used to write programs to collect raw intensity

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data from the spectrometer, to convert the data into a format for C code execution, and to compute the optical properties based on the collected data. To make the process fully automated, the LabVIEW and C code programs were linked together into one single program to allow data to be passed between the two efficiently. The automated program was tested using a tissue mimicking phantom and determination of the absorption and scattering coefficients showed excellent agreement with theory. Future work and the final phase of testing will entail examining actual biological tissue with known optical properties to check for accuracy before proceeding to utilize the system for its intended purpose. Ultimately, the data collection process and algorithms developed through this effort will be applied to build models for light interaction with biological tissue samples.

Vigabatrin-Induced Weight Loss and Locomotor Sensitivity in Normal and Obese Animals. STEFANIE AQUILINA (*Cornell University, Ithaca, NY*); STEPHEN DEWEY (*Brookhaven National Laboratory, Upton, NY*). Vigabatrin, an irreversible inhibitor of GABA-transaminase, decreases dopamine in the central nervous system (CNS). Recent studies suggest that much like drugs of abuse, food increases brain dopamine in obese human volunteers. Combined with previous work using a host of addictive substances, this study focused on an examination of food intake and body weight in an animal model of obesity (Zucker rats). Dopamine is implicated in behaviors associated with addictive drugs, including cocaine, nicotine, amphetamines, alcohol, heroin, and a handful of illicit drug combinations. Unlike other prescription drugs, short-term Vigabatrin use does not appear to have any significant and potentially dangerous side effects. Two minor side effects were thought to include weight fluctuations, as well as locomotor depression. Weight and food intake in normal (adolescent Sprague Dawley rodents) and an animal model of obesity (genetically altered adolescent and adult Zucker fatty rodents) were measured during a period of two sub-chronic Vigabatrin administrations. In addition, locomotor behavior boxes were used to analyze the activity in control animals and those treated with Vigabatrin. Upon treatment with a high dose (150 mg/kg) of Vigabatrin (active enantiomer) in normal rodents, significant weight loss was noted. Treatment in obese rodents, however, resulted in a significantly slower rate of weight gain. These weight loss trends appear dose-dependent (with more extreme weight fluctuations occurring as a result of higher doses of Vigabatrin). However, locomotor sensitivity was not significantly different between Vigabatrin treated and saline treated animals. Thus, locomotor depression does not appear to be a side effect of Vigabatrin. Furthermore, adult rodents treated daily with 300 mg/kg of Vigabatrin (racemic) lost nearly 10% of their body weight in a period of only four days. These studies suggest that Vigabatrin may be an effective treatment for obesity. Additional studies at The University of Pennsylvania, University of California Los Angeles, and Louisiana State University are currently ongoing in human subjects using multiple doses of Vigabatrin and several treatment protocols.

Conflict Resolution is Impaired in Currently Withdrawn Cocaine Addicted Individuals. BAABA BLANKSON (*State University of New York at Stony Brook, Stony Brook, NY*); RITA GOLDSTEIN (*Brookhaven National Laboratory, Upton, NY*). Individuals with cocaine use disorders (iwCUD=CUD) experience neuropsychological impairments that encompass attention and executive function deficits, possibly due to structural and functional changes in prefrontal cortical brain regions. The Attention Network Test (ANT), a computerized reaction time task, has been developed to measure three of these attention and executive function networks: alerting (associated with right hemisphere frontal and parietal regions), orienting (associated with subcortical regions), and executive control (associated with the prefrontal cortex, particularly the anterior cingulate cortex). Our study used the ANT to examine 1) differences between CUD and healthy control subjects in attention and executive function; and 2) the effect of urine status (positive or negative for cocaine use within 72 hours) on attention and executive function in the CUD group. The ANT was administered as part of a larger neuropsychological battery to 84 individuals with current CUD [55 positive (CUD+), 29 negative (CUD-)] and 75 healthy control subjects matched on gender, age, and years of education, but not on race, general intellectual functioning, socioeconomic status, state depression and history of cigarette smoking. Results of three separate ANOVAs revealed a significant group difference in executive control [[$F_{(2, 156)}$ = 5.8, $p < 0.004$; pairwise comparisons: controls faster than both cocaine subgroups, an effect that reached significance for CUD-, $p < .004$, M±SD = 127.5±47.8 for controls vs. 149.4±64.5 for CUD+ vs. 169.8±76.5 for CUD-], but not in orienting [$F_{(2, 158)}$ = 1.0, $p > 0.4$] or alerting [$F_{(2, 157)}$ = 0.2, $p > 0.8$]. The executive control effect remained significant after controlling (with ANCOVA) for general

intellectual functioning, the only non-matched variable that correlated with executive control ($p < 0.03$). The current results suggest that the ability to resolve a cognitive conflict may be uniquely impaired in CUD and expressed primarily during acute withdrawal. Possible explanations may encompass the self-medicating hypothesis (i.e., where cocaine use ameliorates an underlying cognitive deficit in CUD) or the effects of acute withdrawal symptoms on neuropsychological function. The effects of longer abstinence periods and other drug use variables on ANT conflict in CUD remain to be established. Future studies need to also explore the role of the anterior cingulate cortex in underlying this cognitive conflict resolution performance deficit in drug addiction.

Measurement of Methamphetamine-Induced Cue Response in Rodents Using MicroPET. JOSEPH CARRION (*The City College of New York, New York, NY*); WYNNE SCHIFFER (*Brookhaven National Laboratory, Upton, NY*). Methamphetamine (Meth) has seen an increase in use among eighth to twelfth graders. The effects of Meth are similar to amphetamine but even more potent and addictive to the central nervous system. A behavioral model of craving with metabolic imaging using Micro Positron Emission Tomography (MicroPET) was used to determine brain region activation due to drug craving in response to specific stimuli. Conditioned Place Preference (CPP) is an established method of assessing drug-paired environmental responses: Cravings. Twelve male Sprague-Dawley rodents were injected with 5 mg/kg Meth or saline and placed in distinct CPP chambers on alternating days. One day after the 10th Meth pairing, the CPP test was performed while the animal's preference was measured in a drug-free state. From these results, the preference score was calculated as time spent in the saline-paired chamber minus time spent in the Meth-paired chamber. Two days after the last Meth-pairing, animals received an intraperitoneal (i.p.) injection of 18-Fluorodeoxyglucose (18-FDG), and were placed in the Meth-paired chamber. After 45 minutes of FDG uptake, animals were anesthetized and scanned in the MicroPET for 10 minutes. The animals were allowed to rest for one day. Following the rest period, the animals were injected with 18FDG and placed in the saline-paired chamber. The same protocol was followed for all 12 rodents. There was a significant preference for the Meth paired chamber (conditioned animals spent 461 sec in the Meth paired chamber compared to 260 sec in the saline paired chamber, p=0.002). Brain 18FDG data were analyzed using Statistical Parametric Mapping (SPM) and Region of Interest (ROI) methodologies correlated with a preference score. There were significant (p

The Radiosynthesis of 6-(18Fluoroacetamido)-1-Hexanoicanilide for Positron Emission Tomography Imaging of Histone Deacetylases in the Brain. SHANIKA COLLINS (*Medgar Evers College, Brooklyn, NY*); JOANNA FOWLER (*Brookhaven National Laboratory, Upton, NY*). The substrate 6-(18Fluoroacetamido)-1-hexanoicanilide (18F-FAHA) may be useful in measuring the level of histone deacetylase (HDAC) expression and activity in cancer patients via Positron Emission Tomography (PET) imaging and also in studying gene expression in the brain. Inhibition of HDACs triggers growth arrest, differentiation and apoptosis in tumor cells. To evaluate the HDAC expression in the brain and other organs *in vivo*, before and during the use of inhibitors, FAHA was developed as a substrate for the HDAC to allow for non-invasive whole body imaging of the HDAC. Our objective is to prepare 18F labeled FAHA to image HDAC in the brain *in vivo* using PET imaging. FAHA was prepared by the reaction of 6-amino hexanoic acid with thionyl chloride in dichloroethane followed by addition of aniline. The resulting product, compound 1, was then treated with bromoacetyl bromide in the presence of triethylamine to afford compound 2 which was fluorinated using tetrabutylammonium fluoride to give our unlabeled reference compound. The bromine substituted compound will serve as a precursor to 18F-FAHAwhich will be used together with the HDAC inhibitor, suberoylanilide hydroxamic acid for PET imaging of the HDAC expression and activity in the brains of baboons. These studies will form the groundwork for future PET studies in humans to understand the relationship between genes, brain chemistry and behavior.

Dose-Dependent Conditioned Place Preference Response and Locomotor Activity in Methamphetamine-Treated Animals. REEMA DALAL (*New York University, New York, NY*); STEPHEN DEWEY (*Brookhaven National Laboratory, Upton, NY*). Previous behavioral studies indicate that animals exposed to methamphetamine (METH) often associate and prefer specific environments with their exposure, a behavior termed conditioned place preference. The conditioned place preference (CPP) paradigm is a commonly used technique to evaluate the positive or negative reinforcement values of different drugs. These studies closely parallel behavioral responses reported by human substance abusers. In the present study, the procedure

involved several drug pairings where the animals, adolescent male Sprague-Dawley rats, were exposed to different doses of METH in distinct chambers containing well-defined tactile, visual, and/or olfactory cues. Following randomization of the animals, the goal was to expand previous studies, demonstrating that rats will express a CPP to METH exposure by determining a dose-response. For these CPP studies, three groups of animals were exposed to METH at concentrations of 2.5, 5.0, or 10.0 mg/kg. Following twenty consecutive days of pairings (alternating with saline), animals were given access to both chambers in a drug-free state (saline injection). The amount of time spent in the METH-paired chamber was recorded, and was used as an indicator of preference. Further, the locomotor activity was monitored each day and the values obtained on the test day were compared against those obtained for the pre-test. This analysis indicated a significant increase from low-dose to high-dose administration, demonstrating that methamphetamine produced a significant, dose-dependent CPP. Further studies using different concentrations are currently ongoing in a continuing effort to better understand the locomotor and behavioral effects of METH.

Patterning a PDMS Scaffold Towards Wound Healing. *Tejas Doshi* (*Wofford College, Spartanburg, SC*); *Barbara Beckerman, April McMillan, Boyd Evans* (*Oak Ridge National Laboratory, Oak Ridge, TN*). One of the most important functions of skin is to act as a barrier against pathogens. This function is compromised when a person suffers a partial-thickness or full-thickness wound. The wound triggers a healing cascade that consists of three phases: inflammation, proliferation, and tissue remodeling. The rate of wound healing determines if scars form and how quickly skin can regain its purpose to serve as a barrier. Depending on the severity of the wound, the healing process may last from a few days to several months or longer. During the last thirty years, there has been much interest and research in applying micro and nano-scaled technologies to increase the rate of wound healing. These technologies include patterning and functionalization of implantable materials. Patterning involves changing the surface topography of a substrate. Functionalization involves attaching different functional groups or signaling proteins to a substrate. The purpose of this research is to determine a method to increase the rate of wound healing using these micro and nano-scaled technologies. Extensive literature searches were conducted to determine appropriate methods for patterning and functionalizing a scaffold. Polydimethylsiloxane (PDMS) was chosen as the scaffold for the experiments because it has been shown to be biocompatible with the human body. Self-assembled polystyrene-block-polyacrylic acid (PS-b-PAA) diblock copolymer micelles act as the template for patterning PDMS. The goal was to achieve regular, evenly spaced patterns. However, the micelles formed bifurcated striations which did not allow patterning of PDMS. This result is attributed to using PS-b-PAA with a higher molecular mass than described in previous literature. A close substitute was used because the vendor no longer sells the PS-b-PAA described in the referenced experiment. Assuming that the micelles form regular, evenly spaced patterns in future experiments, dermal fibroblasts will be seeded onto molded scaffolds to determine if a patterned surface can best be used to increase proliferation of skin cells so as to also increase the rate of wound healing. Cell proliferation will be measured via a Coulter Counter device. The substrate will also be functionalized with different signaling proteins to induce a greater rate of wound healing. These experiments are the initial stage of a long-term goal to create a therapeutic material that will increase the rate of wound healing.

Biodistribution and Metabolism Studies of 14C-Ethanol in Mice. *Mel Pilar Espaillat* (*Farmingdale State College, Farmingdale, NY*); *Andrew Gifford* (*Brookhaven National Laboratory, Upton, NY*). Ethanol acts as a central nervous system depressant; it is rapidly absorbed by the body, and approximately 90% is metabolized, almost entirely in the liver. The intermediate metabolites of ethanol are believed to be involved in its toxicological properties. The mechanism of ethanol toxicity and its interaction with tissue have not been well understood because of lack of fundamental knowledge about both the pharmacokinetics of ethanol and its metabolism in the human body. This work seeks to study the rate of metabolism of ethanol in different tissues and provide preliminary data for future PET studies to directly measure the distribution and pharmacokinetics of ethanol in human subjects. Mice were injected with approximately 2.0×10^{-3} microcuries of 14C-Ethanol and then were sacrificed at 5, 15, and 60 minute intervals after injection. Plasma and various organs were collected and assayed for carbon-14 under acidic and basic conditions. In the present study a high concentrations non-volatile material was found in the liver, consistent with the role of this organ in metabolizing ethanol.

However, it is notable that other organs were also found to accumulate both ethanol and non-volatile metabolites, although it is not possible to say whether this represents accumulation of circulating radiolabeled metabolites from liver metabolism of ethanol or is due to local metabolism of the radiolabeled ethanol. This work is a small portion of a much larger project being researched to investigate the distribution and pharmacokinetics of ethanol in human subjects.

Effect of Stroke on Regional Distribution of Aromatase and NMDA Receptors in the Female Rat Brain. *Candace Girard* (*Mount Holyoke College, South Hadley, MA*); *Anat Biegon* (*Brookhaven National Laboratory, Upton, NY*). The production of estrogens from precursor androgens is catalyzed by the enzyme aromatase (AR), which under normal circumstances, is restricted to specific neuronal locations. The N-methyl-D-aspartate receptor (NMDAR) is one of the three major subtypes of glutamate receptors, which under normal circumstances, plays a critical role in synaptic plasticity mechanisms. Experimental data suggests that AR activity and NMDARs may be involved in neurodegenerative processes following brain injury. Recent studies have indicated that brain insults can induce brain AR expression and decrease brain NMDAR's. However, the long term effect of stroke w/respect to AR and NMDAR distribution has not been investigated. Middle cerebral artery occlusion (MCAo) in female rats induced stroke and was confirmed in the left hemisphere by MRI and histology. Stroke rats were sacrificed 2 or 4 weeks post MCAo and brain tissue processed for autoradiography. Five control brains (w/surgery; w/o stroke) and five experimental brains (w/surgery; w/stroke) were used in these experiments. Using quantitative *in vitro* autoradiography, AR distribution was investigated with [11C]-vorozole and NMDA distribution with [3H]-MK-801. Regional densities of autoradiograms were quantified with standard image analysis software. The [11C]-vorozole autoradiograms did not show specific or increased binding in our stroke animals. This may be due to the low AR expression in young females and/or a short-lived (<2 weeks) increase in aromatase. The [3H]-MK-801 autoradiograms showed similar regional bainding density in control rats at 2 and 4 weeks. In stroke animals, binding density was decreased at 2 weeks after surgery compared to controls as well as to stroke rats 4 weeks after surgery. These effects were more pronounced in brain regions adjacent to the stroke. The most significant increase in binding between 2 and 4 weeks after stroke was found to be in the frontal cortex (~20%) and denate gyrus (~28%). Binding in the left caudate putamen was significantly lower in experimental rats (~18%). These results, if upheld in a larger series, suggest that hippocampal and cortical NMDAR reduction induced by MCAo is transient, which is in line with the transient nature of many cognitive symptoms often seen in the acute phase after a stroke. This also suggests that damage to the caudate putamen may be sustained or irreversible, in line with the long term nature of motor deficits among MCAo stroke patients.

Microbeam Radiation Therapy: Applying The Method to Spinal Cord Research in Rats. *Meagan Green* (*La Salle University, Philadelphia, PA*); *F. Avraham Dilmanian* (*Brookhaven National Laboratory, Upton, NY*). Presently there are no established methods for stimulating the regeneration of the glial system in animals, yet it is known that the system repairs itself after minor injuries. It has previously been shown that the glial system recovers from irradiation with high dose planes of thin synchrotron x rays. In this experiment we are interested in seeing if irradiation treatment will not only cause recovery of the glial system but also locomotive ability as well. Here we produced contusion injury in the rat spinal cord and irradiated the site with arrays of parallel X-ray microplanar beams. The New York University (NYU) impactor was used to produce contusions to the T9 spinal region once the cord section was exposed by a laminectomy. The injury temporarily paralyzed the rats from the T9 region down. The rats were treated with antibiotics and were placed on heating pads to maintain a steady homeostasis after surgery. They were then irradiated with arrays of thin, parallel x rays (microbeams) at the National Synchrotron Light Source (NSLS). On the day before the irradiations the rats were scored using the Basso et al scale to rank their locomotor ability post surgery yet pre- irradiation. The range is 0–21, with 0 being the worst and fully paralyzed and 21 being the best and fully functional. After the irradiations the rats were scored every four days to test how quickly they were recovering. Within the first two weeks after irradiation the rats' performance appears to improve quickly, yet then it slows down drastically. We saw rapid improvement within the first 14 days after irradiation. On the day of irradiation two of the rats had a score of 3 and two of the rats had a score of 8. On day 14 after the initial irradiation, the two rats with the lower scores, achieved a score of 9.5. The two rats with the higher scored achieved a score of 13. Because of the lack

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of unirradiated controls in this primary study, the interpretation of the results will have to wait until such controls are studied and scored.

National University Consortium Capability Catalog Development. *Michalena Grosshans* (*Ohio Northern University, Ada, OH*); *Roger Mayes* (*Idaho National Laboratory, Idaho Falls, ID*). The Idaho National Laboratory (INL) established a National University Consortium (NUC) to enhance collaboration with university faculty and further integrate university research and development with INL programs. Five Academic Centers of Excellence (ACE), each with a different focus that aligns with the INL mission, have also been established. The NUC schools and the respective ACEs are as follows: Massachusetts Institute of Technology (Advanced Reactor Fuels and Materials Technology), North Carolina State University (Simulation and Modeling), The Ohio State University (Instrumentation & Control and Reactor Safety), Oregon State University (Thermal Fluids and Reactor Safety) and the University of New Mexico (Non-Proliferation Science and Technology). To facilitate collaboration between university and INL researchers, the INL created a catalog of unique equipment, laboratories, projects, software, computers, libraries etc., at each NUC facility, all connected to points of contact. The catalog features data organized by Research Focus, Subcategory, Keywords, Institution, Location, College, Department, Function/Capability, Description, Resource Type, Collaborators/Sponsors/Partners, URL, Point of Contact including phone number and e-mail, and Notes/Miscellaneous Information. The research foci were identified by the ACEs and aligned with the laboratory's strategic plan. During this effort, information available on each university's website was researched thoroughly and gaps in the information were identified. Faculty and researchers at each university have been asked to fill in the gaps. However, most requests are pending response. The catalog is currently configured as an Excel spreadsheet which will later provide INL researchers with an online, searchable database. To maintain this catalog, continual updates will be needed to keep information current. Future efforts will also capture the capabilities of the INL to make the database useful for university researchers. Documentation to support these efforts is available in the form of a user's guide which provides insight as to how the spreadsheet was generated and organized. This will allow someone else to continue project development and potentially help end users improve the quality of their searches.

Δ9-THC Chronic Exposure in Adolescent Rats: Effects on Cocaine Conditioned Place Preference. *Yu Fen Hwang* (*State University of New York at Stony Brook, Stony Brook, NY*); *Peter Thanos* (*Brookhaven National Laboratory, Upton, NY*). Epidemiological studies have shown that use of marijuana during early adolescence is associated with a higher risk for other substance abuse disorders. The extent to which this represents neuroadaptation responses secondary to Δ9-THC (delta-9-tetrahydrocannbinol, main psychoactive ingredient of marijuana), exposure versus genetic vulnerability that underlies high risk with experimentation with drugs in general is unclear. In this study we investigated if chronic exposure of Δ9-THC during the adolescence period in the rat affected the reinforcing responses to cocaine (assessed with condition place preference). Male Sprague Dawley rats (age 3–4 weeks) were administered daily with either Δ9-THC (0.75 and 2 mg/kg) or saline for 21 days. The day after the last injection, we started the Conditioned Place Preference (CPP) segment of the study: [day 1: preconditioning; days 2–9 conditioning phase {cocaine (5 and 10 mg/kg) and saline on alternate days}; day 10: test day]. The results showed that Δ9-THC pretreatment rats resulted in decreased CPP for cocaine (5 mg/kg or 10 mg/kg) On the other hand there were no differences between the group on cocaine induced dose-dependent increases in locomotor activity. These results provide evidence of that exposure to THC during the adolescent period changes the sensitivity to cocaine-induced conditioning. The extent to which this generalizes to conditioning to other drug but also non-drug reinforcers requires further investigation.

Microbeam Radiation Therapy: Treating the 9LGS Rat Brain Tumor. *Nicolle Lanier* (*Suffolk County Community College, Selden, NY*); *Avraham Dilmanian* (*Brookhaven National Laboratory, Upton, NY*). In conventional radiation therapy the limitation in delivering the adequate dose to the tumor is the damage to the normal surrounding tissue. Microbeam radiation therapy (MRT) is an experimental method that uses arrays of parallel, thin (< 100 μm) planes of synchrotron-generated X-rays (called microbeams, or microplanar beams). It allows the normal tissue, including the central nervous system (CNS), to recover from these irradiations at doses many times higher than doses from the conventional beams that severely damage the tissue. The effect has been attributed primarily to the quick recovery of the

microvasculature due to the survival of angiogenic cells between the microbeams. Additionally, at very high doses, single-direction microbeam irradiation kills the tumor in a single session without damaging the surrounding normal tissues, an effect called "the preferential tumoricidal effect of microbeams". However, our recent studies showed that the CNS also tolerates beams as thick as 0.68 mm. We used an array of thick microbeams in a method called "stereotactic microbeam radiation therapy (SMRT)" to treat the rat brain tumor 9L gliosarcoma (9LGS). This method uses irradiations from ten different angles, all crossing the tumor. The rats were irradiated with SMRT at day 15–17 after inoculation (usually done at day 14). Following the irradiation the rats were weighed and otherwise observed daily. The parameters registered were a) if the rat was lethargic, b) if there is any sign of dry blood around the rat's eyes or nose (which are indications of intracranial pressure produced by the tumor), c) if the rat shows epilation over the head where the radiation was aimed, and d) if the rat shows any sign of abnormal behavior (including vocalization upon touch). As of today, 45 days post-inoculation, three of the 15 rats are alive and gaining weight. We plan to repeat the study, this time irradiating the rats at day 14. Research was supported by grants from NIH, Georgetown University, and from the brain tumor foundations of "Musella," "Lauren's First and Goal," and "Have a Chance."

*Synthesis of Suberoyl Anilide Hydroxamic Acid for Positron Emission Tomography Studies of its Inhibitory Effect in Histone. *Frank Ogero* (*Medgar Evers College, Brooklyn, NY*); *Kwesi Amoa* (*Brookhaven National Laboratory, Upton, NY*). Suberoyl anilide hydroxamic acid (SAHA) is a potent inhibitor of cell proliferation. Cell proliferation is caused by the transcriptional role of histone deacetylase (HDAC) an enzyme that influence tumorigenesis of cells. Our research involves synthesizing SAHA via a two-step process. The initial step involved the reaction of suberic acid monomethyl ester with aniline to afford methyl-8-anilino-8-oxooctanoate. This compound was then treated with hydroxylamine to afford the desired compound. SAHA and (18Flouroacetamido)-1-hexanoic acid (18FAHA), a radiotracer for HDAC, will be used to verify the Positron Emission Tomography (PET) image with 18FAHA represents HDAC binding. More specifically, if SAHA blocks the uptake of 18FAHA, this will serve as evidence that the image represents HDAC in the brain. These studies will form the groundwork for future PET studies in humans to understand the relationship between genes, brain chemistry and behavior.

Microbeam Radiation Therapy: Dose Distribution Calculations and Mathematical Modeling. *Jennifer Ong* (*University of Illinois at Urbana-Champaign, Urbana, IL*); *F. Avraham Dilmanian* (*Brookhaven National Laboratory, Upton, NY*). Microbeam radiation therapy (MRT) uses arrays of parallel, thin, synchrotron-generated X-ray beams, which, when administered at high dosages, spare normal tissues while damaging tumor tissues, thus exhibiting a "preferential tumoricidal" effect. Implementing MRT in a new stereotactic geometry (SMRT) of cylindrical pencil beams in circular arrays concentrates radiation on the tumor by positioning it at the crossing of ten arrays while exposing surrounding normal tissue merely to single arrays, thereby maximizing absorbed dose to the tumor and minimizing damage to healthy tissues. The irradiation port positions for the new geometry were calculated using the computer program Matlab and then applied to the rat brain tumor model experiments conducted at the National Synchrotron Light Source (NSLS). The Monte Carlo code MCNP5 was then employed to simulate the absorbed radiation dose profiles resulting from a 309-microbeam SMRT array with radius 1.5cm in a spherical water phantom model of a human brain and tumor. Superimposing a volumetric mesh tally of 150 μm x 150 μm x 1 cm voxels on the phantom and using a photomultiplier in order to obtain absorbed dose from 1 billion incident photon events yielded relative errors. In order to utilize SMRT geometry in animal model experiments and ultimately on human carcinoma, determination of the beam port angles, as well as an analysis of the spatial distribution of the dose in exposed tissues, is needed.

A Review of Empirical Methods for the Derivation of Parameters in a Theoretical Model of Matrix Metalloproteinase 2 & 9 Proteolysis of Collagen Type IV. *Elizabeth O'Quinn* (*Wofford College, Spartanburg, SC*); *Kara Kruse* (*Oak Ridge National Laboratory, Oak Ridge, TN*). Cardiovascular disease is the leading cause of death in first world countries. An imbalance of matrix degrading enzymes and structural proteins within the extracellular matrix of an arterial wall is a critical factor in cardiovascular disease processes. An increase in matrix metalloproteinase-2 (MMP-2) and matrix metalloproteinase-9 (MMP-9), as part of the inflammatory process, results in degradation of collagen type IV influencing the migration and proliferation of vascular smooth muscle cells; this can lead to further narrowing of a diseased artery. Kinetic modeling of

proteolysis is an approach which can be used to understand complex systems by describing enzymatic mechanisms, cellular processes, and the system's behavior quantitatively. In this research project, a computational model of the biochemical pathways involved in activation and inhibition of MMP-2 and MMP-9 proteolysis of collagen type IV is being developed from empirical data and published data. Separate and integrated models of MMP-2 and MMP-9 pathways have been implemented within JSim, a software application developed by the University of Washington. In addition to the enzyme model a cellular migration model is also being developed for the simulation of VSMC migration and will be explored further. The utilization of reverse-phase high pressure liquid chromatography (HPLC) methods for obtaining quantitative reaction rate parameters are being explored for the estimation of parameters not previously published in the literature. By pairing HPLC separation with spectrometry techniques, protein and peptide identification and quantification are possible. Experimental protocols for the measurement of the enzymatic activity of MMP-2 and MMP-9 proteolysis of collagen type IV are being developed to obtain empirical data. These experimental results are then analyzed to derive the rate parameters needed in the computational model. The use of HPLC methods to analyze the enzymatic activity and cellular activity provides parameters which cannot be obtained through literature. This research is in collaboration with the Vascular Research Laboratory at the University of Tennessee Medical Center in Knoxville.

RS-GVG blocks methamphetamine-triggered reinstatement of the expression of methamphetamine-induced conditioned place preference. *Jessica Pai* (*New York University, New York, NY*); *Stephen Dewey, Wynne Schiffer* (*Brookhaven National Laboratory, Upton, NY*). This study investigated the effects of RS-GVG on the reinstatement of the methamphetamine (METH)-induced expression of conditioned place preference (CPP) in adolescent male Sprague-Dawley rats. The expression of a CPP response correlating to dosage was first examined by subjecting three groups of animals (n=8) to 30-minute pairings of METH (2.5, 5.0, and 10 mg/kg, respectively) with one chamber and 30-minute pairings of saline in the other on alternate days over a 20-day period. Following completion of the METH regimen, a CPP response was established. Subsequent daily testing identified the rate of extinction for each group. On test days, animals received saline and were permitted free access to both chambers for 20 minutes. The amount of time spent in the METH-paired chamber was used to determine the conditioning score. This test was performed until the expression of the CPP response was extinguished (defined as 5 consecutive days without a significant CPP, p < 0.05).

Food Stimulation in a Rat Model of Obesity: Food Seeking Behavior as Assessed by Nose-Poke Activity and Locomotor Responses in the Open-Field. *Lisa Robison* (*Colgate University, Hamilton, NY*); *Peter Thanos* (*Brookhaven National Laboratory, Upton, NY*). Food intake is regulated by factors that modulate caloric requirements, as well as food's reinforcing properties. Apart from genetic factors, there are also environmental factors that play a very important role in obesity, including society, culture, stress, food palatability and food availability, as well as food-related cues. Previously, we showed that exposure to an appetitive food stimulus had significant effects on brain glucose in both humans (Wang, *et al.*, 2001) and rodents (Michaelides, *et al.*, 2006). In this study we examine the effect of genetically-induced obesity and food restriction on seeking and learned behavior before and after classical conditioning of a food (bacon) olfactory stimulus. Zucker Obese (Ob) and Lean (Le) rats were divided into 4 groups: i) Ob *ad lib* fed, ii) Ob food restricted (70% of *ad lib*), iii) Le *ad lib* fed and iv) Le food restricted rats. Leptin-receptor deficiency mixed with an unrestricted diet showed the greatest significant amount of novelty-seeking.

Molecular Cloning of Epitope-Tagged Mitochondria Fission and Fusion Genes. *Joly Shah* (*Tallahassee Community College, Tallahassee, FL*); *Andrew Gifford* (*Brookhaven National Laboratory, Upton, NY*). There are two different types of proteins in mammalian cells Drp-1 and fis-1 which are involved in mitochondria fission. In contrast, there are three different types of proteins in mammalian cells OPA-1, Mfn-1 and Mfn-2 which are essential for fusion of mitochondria. But the central idea of this project is to make epitope tagged Drp1 or OPA1 DNA constructs to study these proteins in cultured cells. Epitope are short stretch of peptides that are antigenic. Proteins attached with epitope can be detected by antibody that recognizes epitope. To make these constructs, we will use DNA recombination and molecular cloning methods. Molecular cloning is the process of generating genetically identical copies of DNA. We will first obtain cDNA clone information of these genes will be purified by using Drp-1 and OPA-1 proteins, in order to receive genetically identical copies of DNA fragments. It is

also necessary to use DNA recombination method to make epitope Flag tagged Drp-1 and OPA-1 in pFLAG-CMV1 vector by growing some bacteria. In order to grow bacteria Precision Scientific Thelco oven was use. To purified plasmid DNA the QIAprep Spin miniprep kit and a centrifuge machine was use. Polymerase Chain Reaction machine was also use in order to isolate fragment of DNA. Fisher Biotech machine was use to find pure DNA and vector. By using this technique DNA was cut and paste in vector to let it grow in clones. Moreover, molecular cloning book was use for the more procedure. The project is still continuing, therefore the result will indicate in future. In conclusion, cloning DNA fragment known as molecular cloning. The purpose of growing DNA is to have large quantities of identical copies of DNA for experiments.

Optical Detection of Cocaine-Induced Brain Function Changes in the Rat Brain *in vivo*. *Melissa Tully* (*State University of New York at Stony Brook, Stony Brook, NY*); *Congwu Du* (*Brookhaven National Laboratory, Upton, NY*). Cocaine abuse increases the risk of life-threatening neurological complications, has vasocontrictive properties and also decreases the metabolism. However, the exact pathophysiological mechanisms underlying cocaine's neurotoxic effects remain incompletely understood. We have developed a multi-wavelength spectroscope (MWS) to simultaneously measure the changes in blood volume (CBV) and tissue oxygenation (StO_2) from the brain surface. We also have developed a Laser-Doppler Speckle Contrast Imaging (LDSCI) for detecting the local cerebral blood flow (LCBF) changes in the living rat brain with a high spatiotemporal resolution. In this study, we applied these new optical techniques and combined them with Laser Doppler flowmetry (LDF) to systematically characterize the effects of cocaine on cerebral blood flow (CBF), CBV, and StO_2 as functions of time in response to cocaine administration, as well to identify the spatial feature of cocaine-induced LCBF changes in the somatosensory cortex of the living brain. Three groups of rats were used in parallel to study the changes in CBF, CBV and StO_2, nd LCBF distribution in response to cocaine administration using the optical systems of LDF, MWS and LDSCI, respectively. Each rat was anesthetized, intubated, and mechanically ventilated, and the physiological parameters, including the heart rate (ECG), respiration rate, mean arterial blood pressure (MABP) and body temperature, were monitored. A craniotomy was then performed above the left somatosensory cortex. An optical fiber-based probe, from MWS or LDF, or a CCD camera of LDSCI was then mounted upon the exposed brain surface. The back-scattered photons from the cortical surface were collected by the optical probe/camera continuously before and after the cocaine administration. The changes of CBF, CBV, StO_2, and LCBF were determined as functions of time Our preliminary results show that the cocaine induced a transient changes in CBF, CBV, and StO_2. The changes in CBF recovered to the baseline within 10–12 minutes whereas the changes in CBV and StO_2 in the brain were relatively longer lasting (>20 minutes). Interestingly, using the LDSCI system, the beta-chloralose anesthetized rats have shown increased blood flow in large vessels and decreased flow in capillaries or the microcirculation within the tissue bed in response to the cocaine administration. These results explored the temporal and spatial features of the cerebrovascular effects of cocaine on the brain, which might provide a better understanding of etiology of cocaine related, stroke and transient ischemic attacks.

A Personality Profile of Cocaine Addicted Individuals. *Catherine Urban* (*State University of New York at Geneseo, Geneseo, NY*); *Rita Goldstein* (*Brookhaven National Laboratory, Upton, NY*). Impairments in higher executive function, such as inhibitory control and decision-making, characterize cocaine addicted individuals; however, the contribution to these cognitive functions of personality traits is not well established. The current study therefore examined differences in personality traits between healthy control subjects and cocaine addicted individuals and the extent to which these differences may be affected by recent cocaine use. Sixty-six cocaine addicted individuals [20 testing negative (CUD-) and 46 testing positive (CUD+) for cocaine in urine, indicative of drug use within 72-hours] and 66 gender-, age-, and education-matched healthy control subjects were administered the Multidimensional Personality Questionnaire (MPQ) as part of a larger neuropsychological battery. The MPQ measures three trait super-factors, each comprised of 3–4 lower order subscales; differences between the groups were examined with four separate MANOVAs. Results revealed significant group differences on all three super-factors such that cocaine abuse was associated with lower positive emotionality [$F(2,131) = 3.8$, $p < .0001$], higher negative emotionality [$F(2,131) = 5.0$, $p < .0001$], and decreased constraint [$F(2,131) = 3.1$, $p < .001$]. These differences were driven by lower social closeness especially

in the cocaine positive subgroup [Mean±SEM=12.3±0.6 for CUD+ vs. 14.0±0.8 for CUD- vs. 15.7±0.5 for controls], higher aggression especially in the cocaine negative subgroup [Mean±SEM=5.7±0.5 for CUD+ vs. 6.7±1.0 for CUD- vs. 3.4±0.4 for controls], and lower self-control in the cocaine positive subgroup [Mean±SEM=14.1±0.7 for CUD+ vs. 16.0±1.1 for CUD- vs. 17.7±0.5 for controls]. These effects remained significant after controlling (with ANCOVAs) for state depression and other demographic variables that differed between the groups. These results suggest significant differences between healthy control subjects and individuals addicted to cocaine in trait measures of personality. Together, the higher negative emotionality (aggression), lower positive emotionality (social closeness) and lower self-control may predispose the addicted individuals to relapse and compulsive drug use, especially under socially stressful situations. The underlying cognitive and neurobiological substrates remain to be elucidated.

Analysis of the Biological Effects of Aspirated Carbon Nanohorn Particles in Mice Using Scanning Near-Field Ultrasound Holography. KATHERINE VENMAR (*Denison University, Granville, OH*); THOMAS THUNDAT (*Oak Ridge National Laboratory, Oak Ridge, TN*). Engineered nanomaterials, because of their enhanced physicochemical properties compared to their bulk form, are finding an increasingly important role in many potential commercial applications. However, the health effects of nanomaterials are not well understood or thoroughly investigated. Therefore, more studies are needed to examine different types of nanomaterials and the biological responses they invoke. The purpose of this research was to examine the effects of aspirating single-walled carbon nanohorns (SWCNHs) *in vivo* using mice. Bronchoalveolar lavage (BAL) and blood samples were collected from two experimental groups, the nanohorn exposed, and the control mice. Three mice from both groups were sacrificed 24 hours and 7 days after aspiration. Gross examination of the number of macrophages versus activated macrophages in BAL samples from the exposed and the control mice suggested a possible pro-inflammatory response to the carbon nanohorns. Employing a unique detection technique, Scanning Near-Field Ultrasound Holography, carbon nanohorns were discovered bound to cell membranes, inside cells, and near cells in both the red blood cells and BAL sample cells. The positioning of carbon nanohorns inside the cells not bound to a membrane suggests that they entered the cell through a process other than phagocytosis. Furthermore, the red blood cells (RBC) in all the exposed blood samples exhibited a distorted phenotype. Such distortions could possibly lead to various pulmonary diseases. From their ability to permeate membranes, cause pro-inflammatory responses, and distort the phenotype of red blood cells, it can be concluded that carbon nanohorns may pose a biological threat.

Chronic THC Exposure: Effects on Sucrose Conditioned Place Preference in Adolescent Rats. ANNA VERDE (*State University of New York at Stony Brook, Stony Brook, NY*); PANAYOTIS (*PETER*) THANOS (*Brookhaven National Laboratory, Upton, NY*). The psychoactive constituent in marijuana Δ9-tetrahydrocannabinol (THC) pharmacologically activates the mesolimbic reward pathways. Similarly highly palatable foods also activate the reward circuitry of the brain. Specifically, administration of THC has been shown to influence the intake of sweet foods. The effect of THC in adolescence hasn't been looked at yet. Adolescence may be characterized as a period when a significant amount of neurobiological and development changes occur. Drug abuse during an early neurodevelopmental period may impact the reward potential and consumption of foods or drugs later in life. Therefore, the goal of the present study was to examine the effect of chronic THC administration during adolescence on the reward potential of sucrose using a conditioned place preference (CPP) paradigm. During the exposure period, 4 week old male Sprague Dawley rats were divided into 3 groups to receive a daily i.p. injection for 3 weeks of either: 1) vehicle (saline) 2) low dose THC (0.75 mg/kg) 3) high dose THC (2 mg/kg). Next, all rats started CPP after the last day of treatment. The CPP timeline encompassed the following: Day 1: Habituation, Days 2–9: Conditioning Phase (10 sucrose pellets on even days and no sucrose on odd days), and Day 10: Test Day. These findings will help gain insight on the impact of chronic THC exposure during a neurodevelopmental period on the subsequent reward potential of natural rewards. Finally these sucrose CPP results will be compared to CPP results to drugs in similar THC pretreated rats (Hwang *et al.*, 2006).

The Role of Bootstrap Resampling to Improve Signal-to-Noise Ratio in PET Images. JOHN ZABROSKI (*St. Joseph's College, Patchogue, NY*); JEAN LOGAN (*Brookhaven National Laboratory, Upton, NY*). Positron Emission Tomography (PET) imaging helps determine the effects of genetic variation, disease, behavior, and drug administration on living systems at the cellular level. However, the amount of information gained from these images is limited by noise due to poor counting statistics related to the half-life of the radiotracer used and the amount injected, which is limited by regulations placed on radiation exposure to human subjects. For some radiotracers this noise also limits the ability to create parametric images for each subject since an image is constructed by assigning the biochemical parameter to each voxel. Group parametric images may overcome these factors, eliminating error due to poor counting statistics by using discrete time-frame averaging (DFA) before assigning the biochemical parameter to the group image. However, the statistical significance that would otherwise be obtained through individual parametric images cannot be determined with a group parametric image, because there is only one image per group. To overcome this, bootstrap re-sampling was used to create additional datasets-bootstrap samples. The initial trial used data collected from the PET radiotracer [11C]-Clorgyline (CLG), which binds to the enzyme monoamine oxidase A (MAO-A). Simulated data was generated from the measured plasma input functions using model parameters (K1, k2, k3) derived from a region of interest analysis of the thalamus where k3 represents binding of tracer to MAO-A and K1 and k2 represent transfer between plasma and tissue. By introducing different levels of random noise to this data we can simulate time-activity curves at the voxel level. Using DFA we then attempted to increase the signal-to-noise. For each simulation, standard error was calculated. Also, each simulation was compared to a bootstrapped standard error, with the number of bootstrap samples necessary to obtain a stable estimate of the standard error systematically determined. Our analysis shows that bootstrap resampling plays a useful role in determining statistics associated with the DFA process. Bootstrap resampling was closest to the true value of the voxel at the highest noise level (a = 8.0). Now that we have tested the validity of DFA in conjunction with bootstrap resampling, the next step is to generate bootstrap parametric images, allowing an assessment of the statistical significance of group differences.

Nuclear Sciences

Investigate How Different Operating Conditions or Different Reactors Produce Different Fission Product Nuclides, Using ORIGEN Code. DAVID ASKINS (*Kansas State University, Manhattan, KS*); CHARLES WEBER (*Oak Ridge National Laboratory, Oak Ridge, TN*). There are many questions in today's age when it comes to the problem of radioactive nuclear waste. With the several different types of engineered nuclear reactors in existence around the world, there are many varied output nuclides that are generated as a result of the broad range of running conditions in certain types of reactors. To determine the theoretical output nuclides ORIGEN/ARP code was used. It is a sequence in SCALE that serves as a fast and user-friendly method of performing nuclear irradiation and decay calculations, using problem-dependent cross sections. All possible reactor types were run with different variables, such as burnup, average power, fuel assembly, enrichment of fuel, percentage of time the reactor was powered up, and the amount of cycles. Once the variables were plugged in, the nuclide output products were taken and compared to those of the same type of reactor under different conditions, and to those of different reactors under different situations and similar circumstances. They were evaluated by first finding the average amount of a nuclide for a single reactor, and then measured up to different reactors by finding either the percent difference between the two nuclides, or the ratio between them. Each reactor type was compared to each of the other reactor types. Following this, the main differences were identified to recognize trends, if any, in the various output products related to the varying reactors. To accomplish this task, for each reactor, several different cases were run, keeping the burnup value the same, while varying the average power and running period. Following the running of each specific case, an executable file, 71process, was created to output all possible fission-product nuclides and their respective weights in gram-atoms. These results were then used to generate Excel spreadsheets with the ratios of how many parts of a given element are produced by one reactor, as compared to another. These ratios were then analyzed for certain trends of nuclides between reactors. At this time no results have been obtained. With nuclear power becoming ever more present in today's power industry, we are inevitably faced with the problem of spent fuel accumulating. Furthermore, with the ever-present threat of nuclear waste falling into the wrong hands, it is essential to be able to identify where such nuclear waste came from. To achieve tangible results, more research should be conducted.